

Application for Conventional Experimental License

Pursuant to Part 5 of the Commission's rules,¹ AST&Science LLC ("AST"), a wholly owned subsidiary of AST SpaceMobile, Inc. ("AST SpaceMobile"), seeks experimental authority to perform limited, ground-based outdoor testing of satellite antennas at AST SpaceMobile's Odessa, Texas manufacturing facility prior to final assembly of commercial spacecraft and integration of the spacecraft with the relevant launch vehicle.²

By way of brief background, AST SpaceMobile is building the first space-based cellular broadband network, called SpaceMobile (the "System"), which will operate directly with standard, unmodified mobile devices.³ To aid in the development of the System, AST SpaceMobile holds several experimental licenses allowing it to test prototype satellites and complementary hardware, and the tests proposed herein complement this broader effort.⁴

The instant tests also reaffirm AST SpaceMobile's commitment to promote United States ("U.S.") space leadership. Specifically, as evidenced by AST SpaceMobile's extensive research, development and manufacturing facilities in West Texas, the company has made a long-term commitment to design and build its broadband satellites domestically.⁵ Of course, for practical and logistical reasons, satellites and components manufactured and/or integrated in West Texas must undergo testing in close proximity.

I. DESCRIPTION OF TESTING

Pursuant to the instant experimental license authorization, AST SpaceMobile will conduct discrete ground tests to verify performance of Q/V-band antennas manufactured for the System. The tests will take place outside of AST SpaceMobile's Odessa manufacturing facility, given that insufficient indoor space exists to conduct the requisite tests. AST SpaceMobile anticipates testing up to six (6) individual antennas per month, and expects the tests to be short duration (approximately 10 minutes per antenna), and not to exceed more than two (2) hours in aggregate per month.

The tests will involve transmissions from two types of antennas: Antenna No. 1 is a proprietary Q/V-band 70 cm circular aperture antenna designed for AST SpaceMobile's commercial Low-Earth Orbit satellites ("70 cm Antenna") and Antenna No. 2 is a pyramidal horn antenna ("Horn Antenna"). The boresights of the antennas will directly face each other separated by approximately 50 meters. Both antennas will be mounted 1.5 meters off the ground in fixed positions within the designated outdoor space, pointing at the horizon without employing uptilt/elevation.

Each test will involve a single 70 cm Antenna and a single Horn Antenna. AST SpaceMobile will use the Horn Antenna coupled with a signal generator and upconverter (See **Exhibit 1.0** or the concurrently filed **Form 442**) to simulate a signal from a gateway ground station uplinking into the eventually space-based 70 cm Antenna. The 70 cm Antenna will transmit in the 37.5-42.5 GHz frequency range and Horn Antenna will transmit in the 47.2-50.2 and 50.4-51.4 GHz frequency ranges. Additional Antenna Technical Specifications are set forth in **Section II** below.

¹ See 47 C.F.R. Part 5.

² The experimental authority sought in the instant application supersedes similar authority sought under FCC File No. 0926-EX-CN-2022, which no longer meets AST SpaceMobile's evolving test objectives.

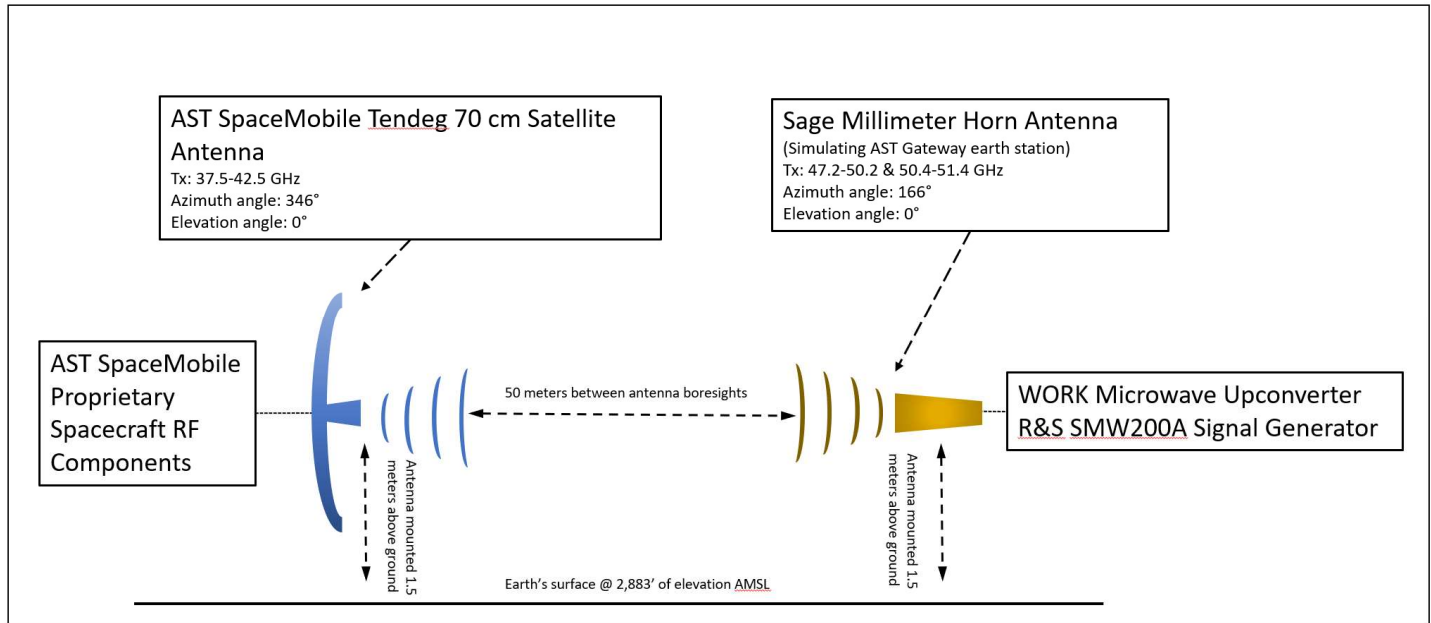
³ AST SpaceMobile is seeking FCC authority to operate its SpaceMobile system in the United States through a Petition for Declaratory ruling filed in 2020. See IBFS File Nos. SAT-PDR-20200413-00034, SAT-APL-20200727-00088 and SAT-APL-20201028-00126.

⁴ See Call Sign WJ2XZZ, Call Sign WK2XCX, and Call Sign WL2XRE.

⁵ Among other investments in U.S. satellite manufacturing, in 2022 AST SpaceMobile commissioned a new 35,000 square foot ISO-8 clean room used for final assembly of the recently launched Blue Walker 3 spacecraft. See <https://www.youtube.com/watch?v=5SHEWwYw7EE> (last visited January 2, 2023).

A diagram illustrating the proposed test set-up follows in **Image 1** below.

Image 1. Test Set-Up



Location

AST SpaceMobile will conduct testing at the company's facility in Odessa, TX:

13600 West I-20, Odessa TX 79706

- LAT: 31°53'20" North
- LONG: 102°15'46" West
- GROUND ELEVATION: 2,883'

Image 2. Aerial View of Odessa Test Site



Image 3. Antenna Orientation at Odessa Test Site



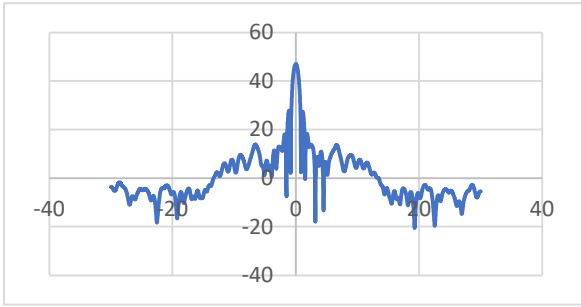
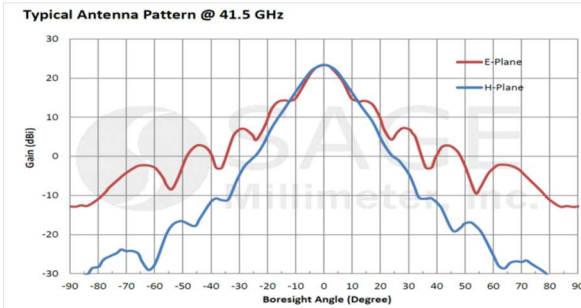
Requested Length of Experimental Authorization

AST SpaceMobile seeks a two-year license.

Stop Buzzer Contact Information

AST SpaceMobile's stop buzzer can be reached on a 24/7/365 basis at the following phone number and email address:
frequencycoordinator@ast-science.com
+1 432 276 3465

II. ANTENNA TECHNICAL SPECIFICATIONS

<i>Antenna No. 1: Tendeg Ka-PDAGimbal 70 cm circular aperture antenna</i>	
<ul style="list-style-type: none"> • Transmit Frequencies: 37.5-42.5 GHz • Power: 2 W maximum • ERP: 61098 W • EIRP: 100237 W • Transmit Gain at 40 GHz: 47 dBi • Pointing Direction: 346° azimuth from true north 	<ul style="list-style-type: none"> • Elevation Angle: 0° • Frequency Tolerance: 0.001% • Emission Designator: 10M0D1D • Modulating Signal: OFDM • Antenna Location: Approx. 1.5 meters above the ground • Input Power Density: 0.2W/MHz
<ul style="list-style-type: none"> • Antenna Sidelobe Pattern: 	
<i>Antenna No. 2: Sage Millimeter WR-22 Pyramidal Horn Antenna</i>	
<ul style="list-style-type: none"> • Transmit Frequencies: 47.2-50.2 GHz and 50.4-51.4 GHz • Power: 2 W maximum • ERP: 286 W • EIRP: 469 W • Transmit Gain at 41.5 GHz: 23 dBi • Pointing Direction: 166° azimuth from true north 	<ul style="list-style-type: none"> • Elevation Angle: 0° • Frequency Tolerance: 0.001% • Emission Designator: 10M0D1D • Modulating Signal: OFDM • Antenna Location: Approx. 1.5 meters above the ground • Input Power Density: 0.2W/MHz
<ul style="list-style-type: none"> • Antenna Sidelobe Pattern: 	

Please see **Exhibit 1.0**, which provides technical specifications for the R&S SMW200A Vector Signal Generator, WORK Microwave Outdoor Block-Upconverter, and the Horn Antenna used to simulate the Earth-to-space gateway ground station transmissions for the purposes of the proposed testing.

III. ENGINEERING ANALYSIS

A. UMFUS Frequencies

Fixed satellite services operate on a co-primary basis in the 37.5-40 GHz, 47.2-48.2, GHz and 50.4-51.4 GHz bands (see 47 C.F.R. Sections 2.106 and 25.136), which include Upper Microwave Flexible Use Services in frequencies up to 51.4 GHz. AST's pending application for market access before the FCC for a commercial non-geostationary satellite network (see IBFS File No. SAT-PDR-20200413-00034; SAT-APL-20201028-00126) will employ these frequencies for feeder link and telemetry, tracking and command communications. The instant tests will evaluate AST SpaceMobile's long-term use of these frequencies for communications consistent with the United States Radio Table and FCC Part 25 rules.

An analysis of the potentially affected population was carried out using Visualyse 7.9.10.8.⁶

All results obtained indicate that Partial Economic Area (PEA) 220 is the only area affected, regardless of antenna model, terrain, and clutter model. PEA 220 Odessa, Texas, comprises Ector and Midland Counties, and has a total population of 274,002 persons.

The worst-case results of the analysis are summarized in the chart below and show that the criteria in §25.136 (d)(4)(ii) and (e)(4)(ii) are met for the planned transmission in the 47.2-50.2 and 50.4-51.4 GHz frequency ranges.

Results – Partial Economic Area (PEA) 220

- All results obtained solely affect PEA 220, regardless of antenna model, terrain and clutter model. PEA 363 and 343 are affected by lower PFD levels than -77.6 dBm/m²/MHz
- PEA 220 Odessa, Texas – comprised of Ector and Midland Counties. PEA 220 Total Population: 274,002
- Free-space loss computed with Rec. P. 452
- Clutter loss computed with Rec. P. 2108 and assumed for Tx antenna side only
- No man-made shielding considered around Tx site
- Terrain Data per Shuttle Radar Topography Mission (SRTM) Version 3 from NASA and US Geological Survey department data, processed for Visualyse 7
- Population data from "Center for International Earth Science Information Network - CIESIN - Columbia University, 2017. Gridded Population of the World, Version 4 (GPWv4): Population Count, Revision 10. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC)", processed for Visualyse 7

Table 4 of §25.136 (e)(4)(ii) (for the protection of UMFUS licensees from the horn antenna transmissions in the 50.4 - 51.4 GHz band, also used for the protection of UMFUS licensees from the 70 cm antenna transmissions in the 37.5 - 40 GHz band)

Population within UMFUS license area	Maximum permitted aggregate population within -77.6 dBm/m ² /MHz PFD contour of earth stations	Results with clutter model Horn antenna	Results with clutter model 70 cm antenna
Greater than 450,000	0.1 percent of population in UMFUS license area.	---	---
Between 6,000 and 450,000	450 people.	23 people (Horn Antenna pointing at 166 from True North)	36 people (70 cm Antenna pointing at 346+45 from True North)
(274,002 people)			
Fewer than 6,000	7.5 percent of population in UMFUS license area.	---	---

Table 3 of §25.136 (d)(2)(ii) (for the protection of UMFUS licensees from the horn antenna transmissions in the 47.2 - 48.2 GHz band, also used for the protection of UMFUS licensees from the 70 cm antenna transmissions in the 37.5 - 40 GHz band)

Population within Partial Economic Area (PEA) where earth station is located	Maximum permitted aggregate population within protection zone of earth stations	Results with clutter model Horn antenna	Results with clutter model 70 cm antenna
Greater than 2,250,000	0.1 percent of population in PEA.	---	---
Between 60,000 and 2,250,000	2,250 people.	23 people (Horn Antenna pointing at 166 from True North)	36 people (70 cm Antenna pointing at 346+45 from True North)
(274,002 people)			
Fewer than 60,000	3.75 percent of population in PEA.	---	---

⁶ The population data estimated from 2020 projections based on the 2000 and 2010 census data found in <http://sedac.ciesin.columbia.edu/data/set/gpw-v4-population-count-rev10> (Center for International Earth Science Information Network - CIESIN - Columbia University, 2017. Gridded Population of the World, Version 4 (GPWv4): Population Count, Revision 10. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC)).

Based on AST SpaceMobile's analysis, while the proposed tests do not strictly meet the $-77.6 \text{ dBm/m}^2/\text{MHz}$ level at 10 meters above ground level as specified in §25.136 (d)(4)(iii) and (e)(4)(iii) due to the proximity of Interstate 20 (main interstate and its business loop) and West Highway 80 E, to mitigate any concerns, AST SpaceMobile is prepared, where required, to implement measures prior to the start of testing to comply with the $-77.6 \text{ dBm/m}^2/\text{MHz}$ level.

AST SpaceMobile is prepared to create manmade shielding to attenuate signals during transmission tests, and/or reduce power commensurately into one or both antennas as needed to ensure compliance with the $-77.6 \text{ dBm/m}^2/\text{MHz}$ level, as confirmed by a secondary analysis using Visualyse 7.9.10.8 in advance of testing. In addition, although AST SpaceMobile understands that at present there are no active UMFUS operations in Odessa, so on a practical level any risk is mitigated, any testing authorized pursuant to the instant application will not commence prior to coordination with active UMFUS license holders in PEA 220, if so required.

Concerning §25.136 (c)(4), (d)(4)(iv) and (e)(4)(iv), AST SpaceMobile understands that there are no active UMFUS operations in PEA 220 (the area for which PFD levels higher than $-77.6 \text{ dBm/m}^2/\text{MHz}$ may be generated as a result of the proposed tests) for the relevant frequency ranges. Nevertheless, AST SpaceMobile will coordinate with all active UMFUS license holders in PEA 220 before conducting the proposed tests.

B. FCC 25.209

The Horn Antenna under test will simulate an Earth-to-space transmission in the 47.2-50.2 GHz and 50.4-51.4 GHz bands but will employ 0 degrees of elevation. Given that FCC 25.209 is intended to protect geostationary satellites from interference resulting from mispointed or inefficient ground stations with inadequate discrimination, the rule is not applicable to an antenna under test pointing at the horizon and with significant discrimination to prevent any energy from reaching the geostationary arc.

C. Off-Axis EIRP Envelopes

For the 70 cm Antenna, AST SpaceMobile's "defined" Off-axis EIRP density envelopes (dBW/MHz) and/or (dBW/4 kHz) (ESD mask), plus and minus from 0 to 10 degrees, 0 to 45 degrees, and 0 to 180 degrees with FCC or ITU envelope superimposed on each measured pattern, in the azimuth and elevation planes:

1. For co-polarized transmissions in the plane tangent to the NGSO arc:

$22-25\log(\theta) \text{ dBW/MHz}$ for $2.0^\circ \leq \theta \leq 7^\circ$
 0.9 dBW/MHz for $7^\circ \leq \theta \leq 9.2^\circ$
 $25-25\log(\theta) \text{ dBW/MHz}$ for $9.2^\circ \leq \theta \leq 19.1^\circ$
 -7 dBW/MHz for $19.1^\circ < \theta \leq 180^\circ$

2. For co-polarized transmissions in the plane perpendicular to the NGSO arc:

$25-25\log(\theta) \text{ dBW/MHz}$ for $3.5^\circ \leq \theta \leq 7^\circ$
 3.9 dBW/MHz for $7^\circ \leq \theta \leq 9.2^\circ$
 $28-25\log(\theta) \text{ dBW/MHz}$ for $9.2^\circ \leq \theta \leq 19.1^\circ$
 -4 dBW/MHz for $19.1^\circ < \theta \leq 180^\circ$

3. For cross-polarized transmissions in the plane tangent to the NGSO arc and in the plane perpendicular to the NGSO arc:

$$12-25\log(\theta) \text{ dBW/MHz for } 2.0^\circ \leq \theta \leq 7$$

D. Radiation Hazard Analysis

Please see **Exhibit 2.0** concerning the radiation hazard analysis with respect to the proposed experimental license and steps AST SpaceMobile will employ to prevent the general public from accessing the test site.